



## Tracking ecogeomorphologic states in renaturalized wetlands in Portugal

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Wetland restoration has become a fundamental part of the EU strategy for biodiversity and climate action. Far from the long-lasting experience of Central Europe, many of the Southern European countries are still in the early stages of wetland restoration, renaturalization or realignment. Indeed, the passive wetland restoration strategy based on the reconversion of abandoned salt pans to wetlands became popular in Portugal over the last decade. In such period we estimate that only 30 ha of natural/passive and managed renaturalization have been conducted in the two main coastal lagoons of Portugal, Ria Formosa and Ria de Aveiro, with a potential for upscaling close to 400 ha.

In this study, we analyzed the long-term lateral adjustment of renaturalized wetlands based on remote sensing data. During ten years of natural evolution, we identified four main ecogeomorphologic states in these environments: (1) hydrodynamic readjustment and sediment infilling; (2) channelization; (3) mud or sand flats construction/destruction and pioneer vegetation colonization; and (4) vertical accretion and replacement of the tidal flat by the low marsh. The morphological development of the tidal flat (and its colonization by primary producers) was relative fast, occurring in the first 1-2 years after renaturalization, whereas the development of a bimodal interface between tidal flat and low marsh occurred at slower rates (colonization with pioneer vegetation started ~ 3 years after renaturalization). Saltmarsh areas increase at rates ranging between 500 and 1 000 m<sup>2</sup>/year in the surveyed salt pans. The degree of habitat formation and ecological succession (and services delivery) has been relatively fast, but the full benefits remain to be realized. Currently, there is no effective management strategy for renaturalized wetlands in Portugal, meaning there are no standard indicators to benchmark the success of observed and conducted interventions. The past adopted renaturalization imposed low initial costs, but long-term losses are likely, as most of them might not be a sustainable long-term solution to cope with sea-level rise and carbon accumulation.

There is now a strong environmental and policy momentum to renaturalize new areas and actively restore wetlands in Portugal. With that in mind overcomes the pressing need for interdisciplinary research on restored wetlands adjustment, merging observations and resilience assessment schemes, as well as the development of biogeomorphologic indicators of evolution (including

ecological successions) after renaturalization/restoration interventions. Also, interdisciplinary research (from natural and social sciences) must be combined with national and regional management plans and policies.